

## BROOD-CARE BEHAVIOR IN *THERIDION JAPONICUM* OBSERVED AT A LABORATORY

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### Synopsis

ITO, Chizuko\* (Department of Biology, Faculty of Science, Nara Women's University, Kitauoyanishi-machi, Nara-shi, Nara, 630 Japan) : Brood-care behavior in *Theridion japonicum* observed at a laboratory. *Acta arachnol.*, 34 : 23-30 (1985).

Observations on the brood-care behavior in *Theridion japonicum* (Theridiidae) were carried out under a laboratory condition by using a video tape recorder.

When a mother spider discovered a prey, she captured and chewed up the prey. Spiderlings began to crowd around the prey and clustered to suck it up about 17 min. later. After about 105 min., they dispersed gradually.

The mother spider fed spiderlings in this way for about 3 weeks until the spiderlings began to take prey by themselves. When the spiderlings were about 7 weeks old, the mother died and her body was sucked out by the spiderlings. Then, spiderlings dispersed and started solitary life.

Thus, *Theridion japonicum* will be ranked as "periodic-social" according to KULLMANN's classification.

### Introduction

Many spiders care for their eggs or egg-sacs, but they usually do not take care of their offspring emerged from the cocoon. However, some spiders feed their spiderlings until they grow to some extent.

KULLMANN (1968) demonstrated experimentally by using a radio isotope that a mother spider of *Theridion sisyprium* (Theridiidae) from Europe feed their offspring by regurgitation. Following species also feed their offspring in a

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similar way; *Theridion impressum* (KULLMANN *et al.* 1971/1972), *Anelosimus studiosus* (BRACH, 1977) (Theridiidae), *Stegodyphus paciphicus* (KULLMANN *et al.* 1971/1972), *S. sarasinorum* (KULLMANN *et al.* 1971/1972), *S. mimosarum* (KULLMANN *et al.* 1971/1972) (Eresidae), and some amaurobiids (GERTSCH, 1949).

Brood-care behavior in spiders is important not only as a link of their life history, but also as a subject for discussing the evolution of social behavior of spiders.

In this paper, the author reported some observations on the brood-care behavior in *Theridion japonicum* which is widely distributed throughout Japan.

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### Methods

Three females of *Theridion japonicum* and their cocoons were collected on 21 and 24 October 1983 in the campus of Nara Women's University. The females of *T. japonicum* whose body length were about 3-5 mm, usually produce several cocoons for days. They were reared individually in plastic containers 6 cm in diameter and in depth, numbered 1, 2 and 3 (Table 1), which were

Table 1. The body length of female *T. japonicum*, and the number of cocoons.

NO.	Body length of female(mm)	NO. of cocoons
1	3.0	3
2	3.0	8
3	4.5	3

placed in the laboratory. The temperature was 2 degrees higher there than outdoors, which was about 20.4°C in the daytime. They were provided with 2-3 fruit flies a day and cotton soaked with water.

Daytime observations on their behavior were carried out everyday from 10:00 a. m. to 6:00 p. m. and night observations were carried out by video tape recording after the spiderlings emerged from the cocoon.

### Experimental analysis

Prey recognition by the spiderlings was checked by removing their mother spider and tolerance of mother to her offspring was checked by exchanging the mother.

## Results

### Emergence of spiderlings from the cocoon

The range of diameter of 12 cocoons was 1.5-4.0 mm and the average number of eggs per cocoon was 20.

Spiderlings emerged only from the cocoon in No. 3 container. No spiderlings emerged from the cocoons in the other containers.

In No. 3 container, 42 spiderlings emerged from the cocoon 2, 59 emerged from the cocoon 1 a week later, and spiderlings did not emerge from the cocoon 3 (Fig. 1).

The body length of the newly emerged spiderlings (second instar) was about 0.6 mm, and their abdomen and cephalothorax were yellow and legs were

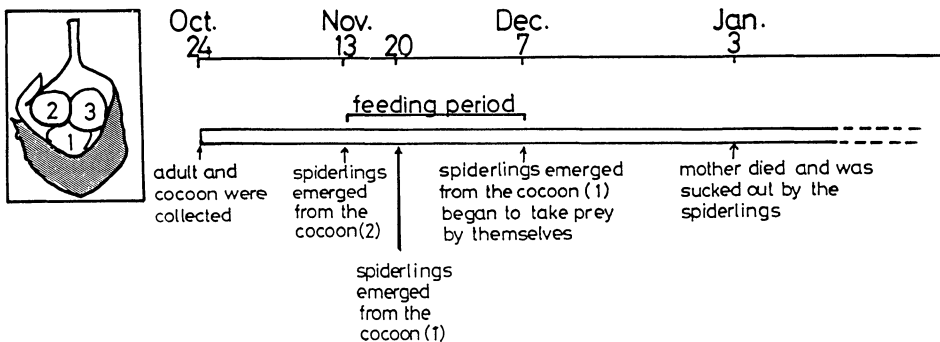


Fig. 1. The time table of brood-care period in *T. japonicum*.

black. Spiderlings emerged earlier from the cocoon 2 mixed eventually with those emerged later from the cocoon 1, and were in contact with each other without any competition.

#### **Feeding process**

Instead of regurgitation feeding, the mother spider of *T. japonicum* captured and chewed up the prey for her young spiderlings (Fig. 2, A-F). The process is shown schematically in Fig. 2 A-F and Fig. 3.

When a living fruit fly was provided as food (Fig. 2-A), the mother spider captured and bit it, while spiderlings were scattered in the web and ignored it (Fig. 2-B). When the mother fed by herself, she bit one point of the prey, while when she provided the prey for spiderlings she bit several points of it. As the mother spider was still biting the prey (Fig. 2-C), several spiderlings came near by in 17 min. after the mother started biting (Fig. 2-D), and then other spiderlings crowded around it one after another (Fig. 2-E). They formed a cluster around the prey after about 25 min. after they started to crowd. During this process, the mother spider as well as crowded spiderlings were biting the prey together. Then she left the prey and went away, and the spiderlings clustered like a bunch of grapes around it (Fig. 2-F). About 105 min. later, the spiderlings dispersed gradually. Three to four hours after the first feeding behavior, a similar process was repeated: that is, twice a night.

#### **Time table of brood-care period**

The mother continued to feed her spiderlings in this way for about 3 weeks (Fig. 1). Since spiderlings emerged from the cocoon 2 were larger than those from the cocoon 1 due to the difference of the day of emerging, the former began to take prey by themselves earlier than the latter. When the spiderlings from the cocoon 2 began to take prey by themselves, the mother spider was still feeding her spiderlings from the cocoon 1. About a month later, the mother died and her body was sucked out by her spiderlings, then they dispersed and started solitary life.

#### **Experiments to check the prey recognition by the spiderlings and the tolerance of mother to her offspring**

When a prey was provided to one week old spiderlings after removing their mother spider, they showed no interest in it even if they came near by or passed it.

When the spiderlings reared in the laboratory with their mother were about 10 days old, another mother with her spiderlings of the same age was collected

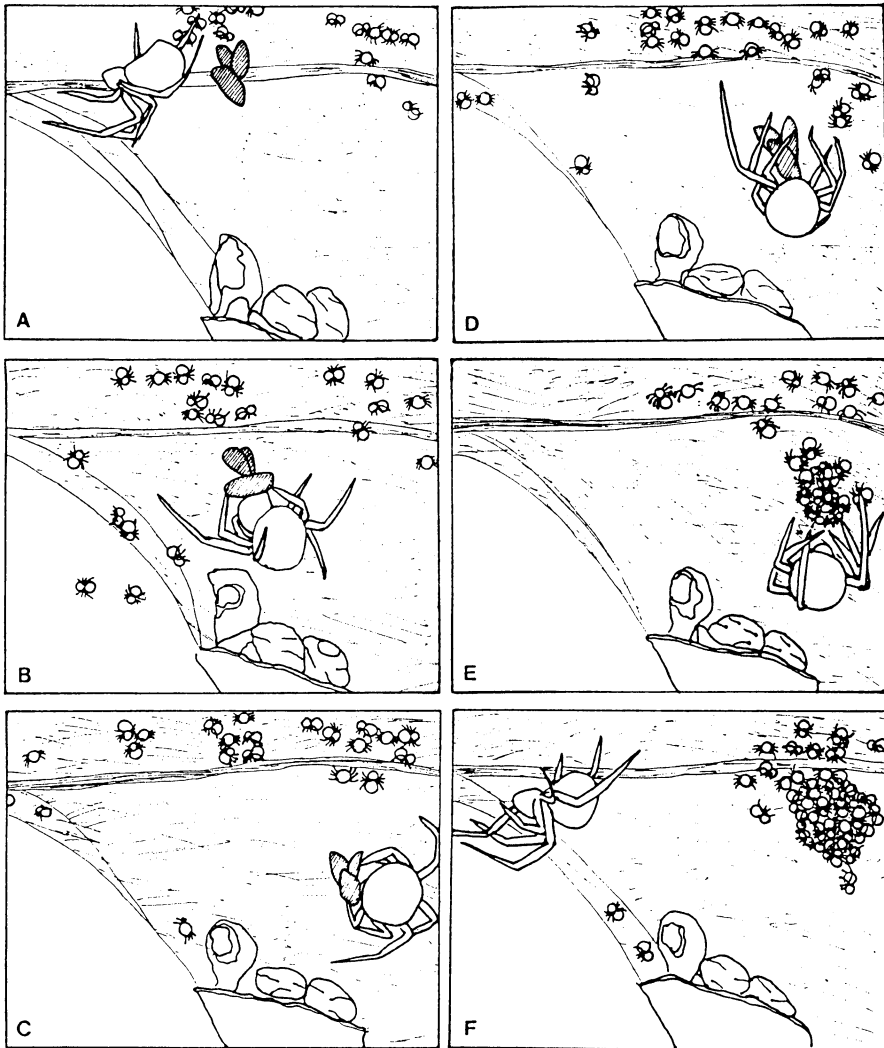


Fig. 2. A series of feeding behavior from VTR. A. Immediately after the prey is provided. The mother spider is left above. A fruit fly (oblique line) is at the right side of the mother spider. B. The mother spider bites at the prey. C. The mother spider still bites the prey, carrying it to the end. D. Several spiderlings come near to the prey. E. Spiderlings crowding about the prey with the mother, upper of it are spiderlings coming along the dragline. F. The mother leaves the prey. Spiderlings are clustering around the prey.

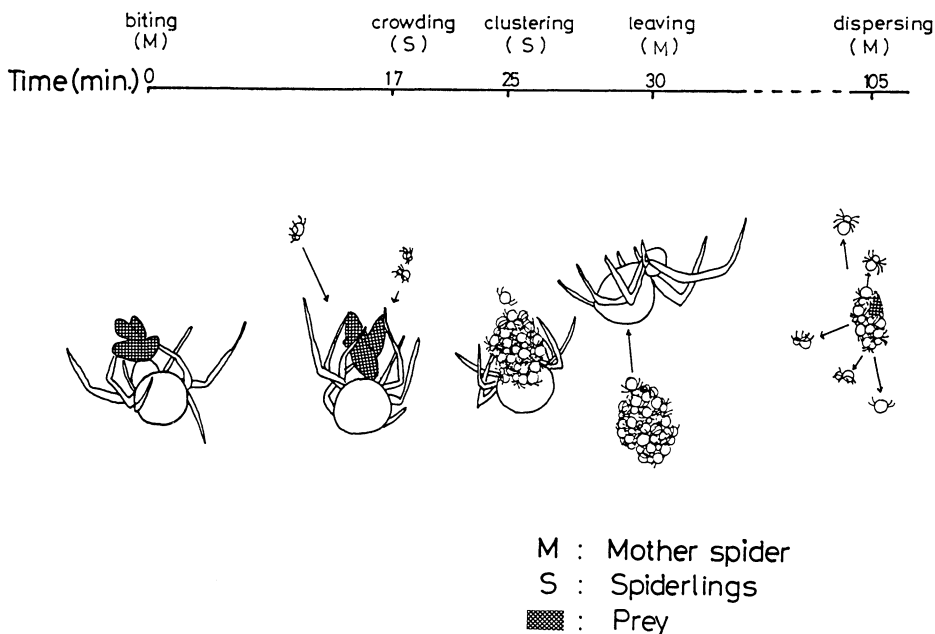


Fig. 3. The time sequence of feeding processes in *T. japonicum*.

outdoors. Then the mothers were interchanged with each other. The result was that both mothers bit the prey and chewed up it for other's offspring. No attack to the spiderlings was observed.

### Discussion

#### Prey recognition by spiderlings

When a mother spider is catching and biting a prey, some factor originating from her seems to play an important role in the prey recognition by spiderlings. There are two possibilities: One is the vibration which is produced by the mother spider during the prey-capture. Another is an attractive substance like pheromone, which may be secreted by the mother spider when she is biting the prey. In the former case, as soon as vibration is produced, spiderlings should perceive it and crowd around the prey. However, the average lag from the time the vibration was produced by mother to the time spiderlings began to crowd was about 17 min. This fact suggests that spiderlings do not use the vibration as a mean of prey recognition. While, in the latter case, the attractive substance

seems to be in digestive juice. However, further experiments are needed.

#### **Tolerance between mother and her offspring**

Another interesting problem is how a mother and her spiderlings distinguish each other from the prey. There is a possibility that different mechanisms exist between tolerance of a mother to her spiderlings and that of spiderlings to their mother.

Tolerance of a mother to her offspring: As it was shown in results, mother spiders can distinguish the spiderlings from the prey at least conspecifically. KULLMANN (1972) reported that females of *T. sisyphium* feed spiderlings from *T. impressum* and vice versa. The same has been observed between *S. lineatus* and *S. sarasinorum*. From these facts, it seems that spiderlings are clearly discriminated from the prey. Pheromones or signals working conspecifically or congenerically should be involved.

Tolerance of spiderlings to their mother: KULLMANN (1972) reported in *T. impressum*, *T. sisyphium*, *S. paciphicus* and *S. lineatus* that the mother spider was sucked out by the spiderlings after her death. Similar behavior was observed in *T. japonicum* in this report. From the fact that spiderlings feed on their mother after her death, cannibalism does not seem to be suppressed completely. If spiderlings regard their mother as a prey even when she is alive, the fact that spiderlings do not feed on their mother may show that a mother is a too strong prey for them. In this case, the reason why living spiderlings do not also feed on each other may be that they emit some signals suppressing mutual attacks. If spiderlings do not regard their mother as a prey until she dies, there must be some factor which causes the change of recognition from a mother to a prey.

#### **Meaning of "prey-biting" by the mother spider**

Since the newly emerged spiderlings are small and their mouth parts seem to be not hard enough, they probably cannot take a large or hard prey. The fang length of spiderlings and their mother spider were measured and compared in *T. japonicum*, and it was found that the fang length of spiderlings ( $63\ \mu\text{m}$ ) was more than three times smaller than that of their mother ( $203\ \mu\text{m}$ ). Thus, biting at a strong prey by the mother seems to be helpful to spiderlings.

When the mother feeds by herself, she bites one point of the prey, while when she provides the prey for spiderlings she bites several points of it. This fact is one of the evidences that the mother is feeding her spiderlings actively.

KULLMANN (1972) categorized three different steps of sociality among cribel-

late Eresidae and cribellate Theridiidae: Asocial, periodic-social and permanent-social. According to this, *T. japonicum* can be ranked into the periodic-social step.

### 摘 要

伊藤千都子\* (奈良女子大学理学部生物学科, 〒630 奈良市北魚屋西町): 飼育条件下での *Theridion japonicum* の子育て行動の観察。

欧米で子育てをする種が多い事で知られている, ヒメグモ科に属するヒメグモの子育てを実験室内での飼育によって観察した。

その結果, 母グモは子グモが自力で餌を獲るようになるまでの一定期間 (約3週間), 餌を捕え咬んだ後に子グモに与える事がわかった。また, この行動の観察および実験から, 親子間に存在するのではないかとと思われる, 相互を許容し合う機構等について考えた。

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